COLORADO STEERS
AND
ASPEN BARK
(1975)

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COLORADO STEERS AND ASPEN BARK (1975)

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Abstract.--To assess the practicality of increasing the value of aspen fiber through use of its bark as a livestock feed, feeding trials were conducted at a Colorado feedlot. Weight gains and carcass grades were slightly lower in steers fed aspen bark than those fed alfalfa roughage. Further livestock feeding research is needed to resolve palatability problems encountered.

INTRODUCTION

Western Colorado has 2.3 million acres of aspen type totaling 5.1 billion board feet of aspen sawtimber (Green and Setzer, 1974). Aspen in the Rocky Mountains is generally considered a low profitability species primarily because of, but not limited to, its small diameter at maturity, its crookedness, its low quality due to knots and a general lack of markets for products. Aspen is often the first stand to become established after a disturbance such as fire, logging, or avalanche. It often serves as a "nurse" cover for relatively shade-tolerant conifers such as spruce and fir. If left unmanaged, areas with this short-lived aspen cover will eventually revert to conifers.

Perpetuation of aspen is needed to benefit the following resources:

- To provide habitat for elk, deer, black bear, beaver, woodpeckers, flamulated owl and other non-game animals and birds.

- For aesthetics, which are enhanced by fall color and landscape variety in form and texture.

- To serve as living firebreaks between conifer stands.

- To enhance recreation experience by maintaining a variety of wildlife and plants.

- For watershed improvement provided by fast-growing and extensive lateral root system of aspen.

It is the premise of the work described herein that profitable utilization of aspen bark will encourage total utilization and improve the economic picture for the species and, therefore, will aid in the management of the species. In addition to forest management benefits, the use of aspen bark to replace hay in rations would help to alleviate hay shortages, especially during dry years, and might reduce feed costs in locations far from hay-growing areas.

Using aspen bark for feed is economically appealing because (a) debarking is a common practice at wood processing plants, (b) bark has an associated disposal cost at the mill and (c) handling and pelletizing costs for feed are minimal. Total manufactured costs for aspen bark are estimated to be $30 to $40 per ton for a commercial operation compared with hay costs of approximately $65 to $85 per ton.

PAST FEEDING STUDIES

Interest in feeding wood to ruminants as a roughage and an energy source dates back to 1920, when Douglas fir and eastern white pine sawdust were fed to sheep and dairy cows (Baker, Millett, Salter, 1975). However, only the University of Minnesota and the University of Wisconsin have reported feeding trials and experimental testing of aspen bark. The desirability of aspen bark for deer, elk, and beaver is well-noted.

The University of Minnesota trials involved ensiling the bark before feeding to 15 sheep in three different amounts (Table 1). The bark was not pelleted. Chemical composition of the ensiled poplar bark (moisture free) was measured and is shown in the following tabulation:

Chemical composition of ensiled poplar bark (moisture free)

Crude protein	2.2%
Crude fiber	53.7%
P	.03%
K	.22%
C_a	1.16%
N_a	.003%
M_g	.09%
F_e	74.1 ppm
Z_n	140.0 ppm
C_n	7.7 ppm
M_o	0.1 ppm
M_n	21.0 ppm
B	12.7 ppm
S_v	44.1 ppm

Digestibility, determined by differences when compared with a basal mixture, was 36.7% (± 1.66 standard error) on a dry-matter basis. The digestibility of hay is around 55%, depending upon its quality.

Table 1.--Performance and ration of University of Minnesota trial for 13 through 48 days

Number of sheep	5	5	5
Average daily feed, kg			
Aspen bark[1]/	1.78	1.54	1.34
Soybean meal	.23	.13	.045
Oats	--	.34	.068
Average daily weight gain, kg	- .043	.034	.035

1/ 44.4% dry matter

The University of Wisconsin has also reported good success with aspen bark fed to goats (15%, 30%, 45%, and 60% in ration) and has reported higher digestibilities (50%). Further work with sheep at the University of Wisconsin has confirmed these results although, from time to time, some palatability problems were encountered with the sheep.

Trials ending in September 1975 at the University of Saskatchewan in Canada showed that steam and alkali treatments were not successful in raising aspen bark digestibility above 30%.3/

In the spring of 1975, a pilot test of aspen bark feeding as the roughage component of a finishing ration at a feedlot in Montrose, Colorado was initiated. About the same time, aspen feeding trials were planned at South Dakota State University.

TRIAL PREPARATION

Plans

Between March 12, 1975, and June 5, 1975, a project plan, financial plan, cooperative agreement between USDA-Forest Service and Collins Farm feedlot at Montrose, and a cooperative agreement between Collins Farm and participating cattlemen were written.

Bark Procurement

Several logging operations in the Montrose area were cutting aspen on mixed species timber sales. American Excelsior was the one operation cutting only aspen. Their process called for complete removal of all sizes of trees, decking in Olathe, debarking and cutting into 100-inch bolts for later shipment to their Denver plant. A Rosser-type debarker, with a high wood content residue, was in use at this location.

A ring-type debarker, which produced cleaner bark and had higher bark recovery possibilities, was located at Silver Tip Studs in Montrose. Arrangements were made to have the American Excelsior aspen logs delivered to Silver Tip Studs and debarked at a cost of $4 per thousand board feet. Twice during the summer the logs were decked, scaled and debarked to obtain bark volumes needed for the feeding trials. Logs were debarked from two different sources: Little Cone Mountain near Sawpit, Colorado, and the Buckhorn area near Ridgeway, Colorado

3/ Unpublished study

The bark was easily removed and ranged in size up to three square foot strips. No evidence of any disease was found. Some wood, particularly knots, was broken off by the debarker, but was removed before the bark was pelleted. Bark samples were taken frequently throughout debarking, placed in an air-tight container, and shipped to Fort Collins for moisture content analysis. Next the bark was trucked from the collection hopper to a drying area.

Little Cone Mountain bark was dried in a lumber dry kiln with fans operating and kiln doors left open. No heat was applied. Buckhorn bark was air-dried in piles at one end of the Silver Tip Studs log yard. Air drying was found to be the most feasible way to handle the large volume of bark. Several days of 70°+ weather were required to dry the bark from 95% moisture content (oven-dry basis) to 15%. Without periodic "mixing", piles of bark heated to some extent. Spreading bark on an asphalt surface for rapid drying would be suitable, alleviating the need for mixing. A rotary corn dryer would probably be the best method for bark drying.

Bark sample data follows:

	Little Cone	Buckhorn
Scaling sample yield:		
No. of logs	130	155
Bark Volume	503.28 ft^3	434.86 ft^3
Wood Volume	2427.13 ft^3	2296.06 ft^3
Bark % of Total	17%	16%
Moisture content:[1]		
Ave.	95%	91%
Range	60%-122%	78%-116%
Specific gravity		
Ave.	0.448	not
Range	0.38-0.57	determined
Total yield:		
No. of logs	165	686[2]
Bd. ft. (Scribner)	14.1M	43.4M
Green tons of bark	9.6 tons[3]	28.5 tons[3]

[1]/Obtained from bark conveyor samples and log deck samples. Moisture content is oven-dry basis, rather than original-weight basis. For instance, an oven-dry M.C. of 100% would be an original-weight M.C. of 50%.
[2]/Exclusive of 39 logs with no bark.
[3]/These figures represent about 75% of total bark tonnage. About 25% of the bark was lost in handling prior to debarking due to bark slippage on logs cut during the spring.

Bark Processing

Pelleting the bark roughage was determined to be the most accurate and easiest way of handling and measuring. Ute Mills of Montrose was very cooperative in processing the aspen bark. No major problems were encountered. Hammermilling of the bark caused more stress on the equipment than pelletizing. Moisture content of the bark was critical during hammermilling and needed to be near 15%. Both 1/4-inch diameter and 3/8-inch diameter pellets were made with no additives. The 3/8-inch pellet was used in the trials as recommended by Dr. John Matsushima of Colorado State University. Aspen bark was processed and delivered by Ute Mills upon request from the feedlot throughout the trials. Pellets were stored in sacks inside a building at the feedlot.

Cost of Aspen Bark Pellets

Debarking	Cost/Ton
20.35 tons processed	$11.43
.65 waste	
21.00 tons total	
Hauling (storage and drying)	3.10
Hammermilling and pelletizing	18.00
Handling (from storage to mill and feedlot)	2.00
	$34.53

Hay Procurement and Processing

Sun-cured alfalfa hay was purchased through Ute Mills. All hay was assumed to be equal in protein content. The hay was processed through the same mill and 3/8-inch diameter pellets were delivered to the feedlot as requested.

Hay Cost	Cost/Ton
Hay	$65.00
Pelletizing	18.00
Handling	2.00
	$85.00

Procurement of Steers and Feedlot

A well-operated feedlot with good record-keeping procedures was located in Montrose, Colorado. Collins Farms feedlot feeds several thousand cattle annually, has up-to-date equipment and techniques and was willing to cooperate in the project.

Two-hundred steers were solicited through local ranchers to fill the four feeding trial pens. The steers were split into pens as evenly as possible by breed, owner, and weight. The following livestock owners cooperated in the trials: Currier, Collbran (100 head), Hughes Brothers, Norwood (28 head), Raymond Snyder, Norwood (22 head), Jack Dixon, Gunnison (25 head), and Collins Farms, Montrose (25 head).

Public Information

An information booth was set up for display at the Colorado Cattlemen's Association convention, June 19-21, 1975. The purpose of the booth was to inform convention attendees of the why and how of the aspen bark trials. The booth consisted of a series of photos showing the processing of the bark from tree harvest to cattle feeding. Samples of raw, hammermilled and pelleted bark were available for observation. Some people actually tasted the pellets and decided they might be taster's choice to a beaver, but definitely not to them, personally. Literature describing these trials and similar research was available to the public. To answer any questions that might arise, the booth was manned by Forest Service personnel Tom Weldon, Jim Free and Wendell Turner.

Information regarding the trials appeared in Montrose, Grand Junction, and Denver newspapers. Additional articles appeared in other magazines and newspapers.

FEEDING TRIALS

Dr. Matsushima designed the initial feeding ration for the trials, monitored the division of steers into pens, made later feeding ration changes and graded carcasses at the end of the trials.

The two-hundred yearling steers were divided into four pens. Two of the pens were to be fed aspen pellets as roughage and the and the other two were to be fed alfalfa pellets. On June 17, 1975, the steers were eartagged, pen-branded, weighed and assigned to one of the four pens on a rotational basis. All of the steers were given the regular treatment of grub and rednose control, and were given Lepto vaccinations prior to weighing.

Approximately 50% of the steers were Limousine-Hereford or Charolais-Hereford crosses, 15% Hereford-Angus cross, with the balance composed of Herefords or mixed crosses. Considerable variation was noted in the size of steers with starting weights varying from 500-950 pounds. The average initial weights were 667 pounds for the aspen group and 673 pounds for the control or hay-pellet group.

The rations for both groups were designed to contain approximately 11% protein on an air-dry basis. The guidelines for feeding each group were set up at the beginning of the feeding trial. Six rations for each group were planned so that, as the feeding period progressed, energy content in the ration would gradually increase. The initial ration (Ration 1) for the aspen group contained approximately 25% aspen pellets and the finishing ration (Ration 6) contained approximately 5% aspen pellets.

Because difficulty was experienced in getting the steers to consume the intended levels of aspen pellets, the rations were modified. Consequently, feed consumption shown later in the text will not correspond to that originally planned.

The original plan was to feed the steers on aspen bark the following: aspen bark pellets, corn silage, flaked corn, and protein supplement. As the feeding period progressed, the corn silage was to be gradually removed so that aspen pellets would serve as the only roughage. However, there was difficulty in getting the steers to consume the desired level of feed. This in turn, was affecting weight gains in the steers. The level of aspen bark was subsequently decreased and haylage (ensiled alfalfa hay) was added to the ration so that the roughage level in the ration would correspond to the control group. Corn silage was increased during July, and then dropped from the ration until November.

On June 30, 1975, two weeks after the trials started, the steers were "backing off" the rations shown in Table 2.

Table 2.--Feeding Ration as of June 30, 1975

	CONTROL			ASPEN		
	Daily Consump.	Dry matter[1]/ Consump.	TDN[2]/ Consump.	Daily Consump.	Dry matter[1]/ Consump.	TDN[2]/ Consump.
Corn	9.8	8.82	7.84	9.6	8.6	7.68
Protein	0	0	0	4.2	3.8	2.94
Hay pellets	9.8	8.82	4.9	0	0	0
Corn silage	7.68	2.3	1.55	10.0	3.0	2.0
Aspen pellets	0	0	0	2.5	2.2	1.25
TOTAL		19.94	14.29		17.6	13.87

1/ Dry matter values used: 90% D.M. for all feed except for corn silage which 30% D.M. was used.
2/ TDN values used: Corn = 80%; protein = 70%; hay and Aspen pellet = 50%; corn silage = 20% (on natural basis).

The difference of 2.3 pounds of dry matter intake per head between the two groups had an adverse effect on the gain of the steers fed aspen bark. Therefore, at this point, the recommendation was made to decrease the amount of aspen pellets in the ration. On July 1, 1975, the aspen pellets were reduced to two pounds per head per day. After a couple of weeks, the feed consumption began to increase and consequently, the aspen pellet consumption increased back up to around 2.6 pounds per head daily. However, on a percentage basis, the level of aspen in the ration had not increased. About July 1, salt was mixed with aspen bark in the pellets. Then, during mid-August, the condition of the steers and the feed consumption records were examined. A decision was made to drastically reduce the quantity of aspen pellets in the ration.

On August 16, 1975, the aspen pellets were reduced to a level of less than one pound per head daily. Then, as the feed consumption increased, the consumption of aspen pellets increased to about 1.25 pounds and remained at this level for the remainder of the feeding trial.

The aspen pellets were estimated to be around 3% protein, but the composite figure for several batches of the pellets turned out to be 4.81% on an as-is basis or 5.0% on dry matter basis. The fiber content of the aspen pellets was 28.81% on natural basis or 30.3 % on dry matter basis.

RESULTS

The major findings of the feeding trial are reported in Table 3. The gains, feed efficiency and the slaughter-carcass data are all reported in the table. Feed cost comparisons are shown.

As noted in Table 3, the steers fed aspen bark pellets gained 4.15% less than the control steers (2.77 pounds daily gain versus 2.89 pounds). The lower gain must be attributable to the lower feed consumption encountered during the early part of the feeding period. Once the level of aspen in the ration was decreased, the total feed consumption increased. The steers that were fed aspen bark showed a marked increase in corn consumption during September, October, and November. This accounts for the larger figure shown for the average daily corn consumption (16.71 pounds flaked corn for aspen steers versus 15.88 pounds corn for control steers). Table 4 shows cost/lb. of feed and daily cost/head for feeding. Table 5 shows feed consumption by month.

A larger quantity of protein supplement was included in the ration for the steers fed aspen bark because of the low protein content in that feed. During the first 80 days, this commercial protein supplement (40% protein with 20% protein equivalence from urea) was fed to the aspen group. From September 7, 1975, a commercial protein supplement (32% protein with 19% protein equivalence from urea) was fed to both groups.

Since the steers on aspen pellets gained less and consumed more feed than the control steers, the control steers were 5.19% more efficient in their gains.

Table 3.--Aspen Feeding Trial Results (June 17, 1975 to November 23, 1975)

	Control	Aspen
Number of Steers	100	99[8]/
Number of Days Fed[7]/	149	147
Initial Weight, Lbs.	673	667
Final Weight, Lbs.	1100	1074
Total Gain, Lbs.	427	407
Average Daily Gain, Lbs.[9]/	2.89	2.77
Average Daily Ration, Natural Basis, Lbs.:		
Grain (Flaked Corn)	15.88	16.71
Protein Supplement (Commercial)	0.91	2.43
Aspen Pellets	---	1.84
Hay Pellets (Alfalfa)	8.41	---
Corn Silage[1]/	1.26	3.31
Alfalfa Haylage[2]/	2.43	12.89
Air Dry Feed, Lbs.	26.55	27.13
Feed Required/Lb. Gain	9.25	9.79
Dressing Percent[3]/	62.9	62.8
Liver Condemnation, %	29.7	12.24
USDA Carcass Grade[4]/	15.0	14.9
% Choice	27.7	18.4
% Good	73.0	82.5
Fat Thickness, In.	0.58	0.57
Ribeye Area, Sq. In.	13.1	13.0
Kidney, Pelvic Fat, %	2.5	3.1
% Cutability[5]/	50.16	50.09
Yield Grade[6]/	2.95	2.97

1/Corn Silage = 70% moisture.
2/Haylage = 60% moisture.
3/Cold carcass weight divided by delivered weight.
4/USDA Grade: 16 = Low Choice; 15 = High Good.
5/% of carcass weight in boneless, closely trimmed, retail cuts from round, loin, rib, and chuck.
6/Yield grade 2 = 52.3 to 50.3% cutability.
7/Approximately half the steers were fed for 134 days, and the other half for 160 days.
8/Steer Number 147 was removed from this pen July 19, 1975.
9/Statistically significant as 5% level.

Table 4.--Feed Cost (1975)

	1975[1]/ Cost/Lb.	CONTROL Daily Cost/Head	ASPEN Daily Cost/Head
Average Daily Ration, Natural Basis, Lbs.:			
Grain (Flaked Corn)	$0.060	$0.95	$1.00
Protein Supplement (Commercial)	0.080	0.07	0.19
Aspen Pellets	0.017	---	0.03
Hay Pellets (Alfalfa)	0.042	0.35	---
Corn Silage	0.011	0.01	0.04
Alfalfa Haylage	0.015	0.04	0.19
TOTAL (Natural Basis)		$1.42	$1.45

[1]/Costs for flaked corn, protein supplement, corn silage, and alfalfa haylage from Collins Farms; costs for aspen & hay pellets from USFS calculations.

Table 5.--Feed Consumptions by Month (as fed basis)

STEERS FED ASPEN BARK						
	Protein Supplement	Flaked Corn	Corn Silage	Haylage	Aspen Bark Pellets	Salt
6/17/75- 6/30/75	5,680	9,300	14,550	--	5,330	22
7/01/75- 7/31/75	8,880	40,390	33,480	37,440	7,910	109
8/01/75- 8/31/75	8,095	49,870	---	67,200	6,110	48
9/01/75- 9/30/75	5,220	53,740	---	40,750	3,000	--
10/01/75-10/31/75	5,200	63,670	---	29,580	3,350	--
11/01/75-11/23/75	2,300	26,240	100	12,580	1,360	--
TOTAL	35,375	243,210	48,130	187,550	27,060	179

CONTROL STEERS						
	Protein Supplement	Flaked Corn	Corn Silage	Haylage	Aspen Bark Pellets	Salt
6/17/75- 6/30/75	---	13,190	10,220	---	13,260	30
7/01/75- 7/31/75	---	42,900	8,440	10,160	29,520	58
8/01/75- 8/31/75	---	48,840	---	20,590	25,360	20
9/01/75- 9/30/75	4,700	50,840	---	5,200	21,560	--
10/01/75-10/31/75	6,070	54,660	---	---	24,260	--
11/01/75-11/23/75	2,760	24,620	---	---	10,570	--
TOTAL	13,530	235,050	18,660	35,950	124,530	108

The steers in the feeding trial were shipped to Denver on three different dates. The first group, consisting of 44 control and 45 steers fed aspen bark, were shipped on October 29, 1975. Since a high percentage of the steers did not make the choice grade, it was decided to delay the shipment on the balance of them. Four weeks later, the balance of the steers were slaughtered. Based upon the records, the extra four weeks of feeding didn't improve the carcass grades: 22% of the steers fed aspen bark were graded choice in the first shipment, and 15% graded choice in the second shipment. In comparison, 29% and 23% of the control steers were graded choice in the first and second shipments, respectively.

It is difficult to determine why a larger percentage of the steers in either group did not grade choice. Degree of marbling is the major factor which determines the quality grade (to grade choice, good, etc.). Available data indicates that yearling steers fed either for 130 days or over or with grain

consumption exceeding 2,200 pounds per head should grade 70% choice or better. In both the group fed aspen bark and the control group, the grain consumption exceeded this level (actual corn consumption was 2,432 pounds for the group fed aspen bark and 2,351 for the control steers).

In summary, the results of the trials were as follows:

- Liver condemnation was lower in the steers fed aspen bark. Condemnation percentages were identical to a recent Canadian study.

- Sickness was noted in only one of the steers fed aspen bark.

- Gain was 4.15% less in the aspen bark fed steers, and was probably due to lower feed consumption during the early part of the feeding period.

- Even though larger amounts of corn silage and alfalfa haylage were fed than planned, the daily feed cost per head for the steers fed aspen bark was only 3¢ higher than the control group.

- Choice carcass grade was 9.3% lower in the aspen bark group than in the control group.

- Carcass data, other than liver condemnation, gain, and grade were very similar for the two groups.

The following problem summary should help facilitate planning of possible future feeding trials. Problems were:

- Delay in planned delivery of aspen logs to the mill due to wet spring logging conditions.

- Bark loss (about 25% of the total) between the stump and the mill due to bark slippage on logs cut in the spring.

- Need for bucking tree-length aspen into shorter lengths to accomodate the ring debarker at Silver Tip Studs due to the high amount of crook and sweep in the aspen.

- Lack of adequate available bark drying facilities at Montrose

- Difficulty in hammermilling bark above 15% moisture content. This was attempted once.

- Steers "backing off" the aspen bark pellet ration, which resulted in modifying the ration to maximize weight gain on these steers

- Low % of choice grade in both the control and the aspen bark steers.

- Because of ration changes, the proportion of grain to roughage between the two rations are not comparable. Consequently, the differences in weight gain of the steers, feed consumption, carcass grades and all the other parameters compared, cannot necessarily be attributed to the aspen bark included in the ration.

CONCLUSIONS

Further research in feeding aspen bark to steers is needed to help resolve the question of palatability and other problems encountered in this pilot test. It is evident that some other ingredient, such as dehydrated hay, should be mixed in with the aspen bark before pelleting.

Wildlife (deer, moose, elk, antelope, mountain sheep) feeding tests are being conducted with aspen bark by Wyoming Game and Fish near Wheatland, Wyoming. A report will be written upon completion of the trials. Further investigative work should be done in this area, if indicated from the Wheatland trials.

LITERATURE CITED

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Other people who participated in conducting these trials and writing this report are:

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- Jim Free, District Ranger, USDA-Forest Service, Canon City, Colorado.

- Wendell Turner, Range Conservationist, USDA-Forest Service, Montrose, Colorado.

- John Minow, Deputy Director, Range and Wildlife Management, USDA-Forest Service, Denver, Colorado.

APPENDIX

1. Initial weights and carcass data
2. Results of South Dakota feeding trials

ASPEN BARK FEEDING TRIAL -- CONTROL

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
1	Ch x H	535	1036	666	.5	4+	12.1	10	Gd+	2	
2	H	590	1033	664	.5	3	11.8	8	Gd	3	
3	Ch x H	545	1104	713	.3	2	16.4	13	Gd-	-	Absc.
4	BWF	530	969	620	.5	4	12.6	8	Gd+	3	
5	H x Sh	505	1033	664	.4	5-	13.4	14	Gd+	2	
6	H	530	902	574	.6	2	13.9	7	Gd-	3	
7	Ch x	520	1046	673	.5	3	13.4	11	Gd	2	Absc.
8	Bl	570	1110	717	.6	4	12.8	12	Gd+	3	
9	BWF	600	944	603	.5	4	12.6	9	Gd+	2	
10	BWF	770	1327	867	.6	5-	14.4	11	Gd+	3	
11	BWF	660	1075	693	.6	6	13.1	10	Ch-	3	
12	BWF	715	1210	786	.7	5-	14.3	14	Ch-	3	
13	Brockle	640	1062	684	.8	4+	12.8	12	Ch-	-	
14	BWF	600	1033	664	.5	7	13.9	12	Ch	3	Absc.
15	H	640	1002	643	.6	7	13.9	11	Ch	3	
17	H	635	1120	724	.7	3+	13.9	12	Gd	3	
18	H	555	959	613	.4	6	10.9	8	Ch-	3	Absc.
19	H	730	1120	724	.5	4	12.8	11	Gd+	3	
20	H	690	1094	706	.6	6	13.5	9	Ch-	3	
21	Bl	865	1175	762	.7	6	13.2	12	Gd+	-	
22	H	700	1004	644	.6	5	12.6	10	Gd+	3	
23	H	700	1076	694	.6	5-	13.8	9	Ch-	3	Absc.
24	BWF	880	1202	781	.8	7	13.9	12	Ch	3	
25	H	670	1094	706	.6	2	11.4	9	Gd-	3	
26	H	660	1075	693	.5	4-	13.2	10	Gd	3	
27	Lim x	755	1162	753	.5	5	14.1	10	Ch-	3	
28	Lim x	870	1200	779	.5	3	14.2	15	Gd	3	
29	H	735	1143	740	.5	3	15.3	10	Gd	2	
30	Ch x	830	1201	780	.8	5	14.4	11	Gd+	3	
31	H	765	1139	737	.9	4+	12.1	9	Gd-	-	
32	H	795	1211	787	.6	4+	12.3	11	Gd+	3	

Continued...

ASPEN BARK FEEDING TRIAL -- CONTROL (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
33	H	635	1046	673	.6	3	11.9	10	Gd	3	
34	H	635	965	617	.6	3	13.5	8	Gd	3	Absc.
35	Lim x	640	984	630	.6	4	12.8	9	Gd+	3	
36	H	620	992	636	.5	4	12.8	9	Gd+	3	
37	Lim x	610	955	610	.6	4	12.9	10	Gd+	3	
38	H	605	1008	647	.6	5-	12.7	10	Gd+	3	
39	H	785	1195	776	.6	4	13.9	12	Gd+	3	
40	H	620	944	603	.5	2	12.1	6	Gd-	3	
41	H	670	1085	700	.6	4	13.6	12	Gd+	3	
42	H	695	1042	670	.7	4	10.1	10	Gd+	3	
43	Ch x A	750	1166	756	.6	5-	14.9	11	Gd+	2	Absc.
44	H	650	1081	697	.7	4+	13.4	10	Gd+	-	
45	H	695	1152	746	.5	4	13.9	11	Gd+	2	Absc.
46	H	650	1004	644	.7	4+	10.3	10	Gd+	3	
47	Lim x	945	1400	917	.7	6	14.3	12	Ch-	3	
48	H	555	1023	657	.6	4+	14.3	10	Gd+	2	
49	Lim x	630	984	630	.5	5-	13.3	10	Gd+	3	
150	H	560	1023	657	.4	3	15.4	11	Gd	1	
50	Lim x	620	960	614	.6	4	11.1	11	Gd+	3	Absc.
51	Ch x H	585	1047	674	.5	4	13.3	8	Gd+	2	Absc.
52	BWF	545	981	628	.5	2	12.8	9	Gd-	3	Absc.
53	Brockel	580	1024	658	.5	3	12.4	7	Gd	3	Absc.
54	H	505	930	593	.4	4+	11.1	7	Gd+	3	
55	Ch x H	580	952	608	.5	3	12.8	11	Gd	2	
56	H	505	905	576	.5	4	12.3	9	Gd+	2	Absc.
57	BWF	530	953	609	.5	4	12.2	11	Gd+	3	Absc.
58	BWF	570	969	620	.6	4+	12.4	7	Ch-	3	Absc.
59	Bl	590	1044	672	.5	3	14.3	11	Gd	2	
60	Bl	550	1094	706	.6	5	14.3	12	Ch-	3	Absc.
61	BWF	590	1062	684	.6	7	14.8	11	Ch	3	Absc.
62	BWF	645	1129	730	.6	6	13.8	9	Ch-	3	

Continued...

ASPEN BARK FEEDING TRIAL -- CONTROL (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
63	H	705	1068	688	.6	5-	13.1	12	Ch-	3	
64	BWF	600	959	613	.6	4+	11.9	10	Gd+	3	
65	H	625	1065	686	.7	3	12.1	11	Gd	3	
66	H	585	840	531	.5	4	12.1	5	Gd+	3	Absc.
67	H	540	960	614	.5	4+	10.8	9	Gd+	3	
68	H	625	1036	666	.6	5-	11.8	9	Gd+	3	
69	Ch x BWF	790	1124	727	.7	7	12.6	13	Ch	-	
70	H	790	1118	723	.6	5	13.4	8	Gd+	3	Absc.
71	RA x H	810	1113	719	.8	7	12.6	10	Ch	-	
72	Brockle	850	1220	793	.6	4+	12.7	12	Ch-	3	
73	BWF	845	1175	762	.7	6	13.5	12	Ch-	3	
74	H	840	1226	797	.8	4	13.5	13	Gd+	-	Absc.
75	H	610	979	627	.5	2	13.8	9	Gd-	3	
76	H	740	1085	700	.8	7	12.2	11	Ch	-	
77	BWF	670	1013	650	.7	4	12.0	10	Gd	3	
78	H	520	888	564	.6	4+	13.1	9	Ch-	3	Absc.
79	BWF	790	1155	748	.4	4	15.1	13	Gd+	2	
80	H	580	891	566	.6	3	13.0	9	Gd	3	
81	H	630	985	631	.5	4	12.6	11	Gd+	3	
82	H	610	923	588	.5	4	13.2	6	Gd+	2	
83	H	780	1143	740	.7	4+	13.2	13	Ch-	-	
84	H	720	1076	694	.6	8	13.2	10	Ch	3	
85	Ch x H	870	1237	805	.5	5	13.7	11	Gd+	2	Absc.
86	Lim x H	830	1216	790	.6	6	13.4	14	Ch-	3	
87	Ch	690	973	623	.6	4-	12.2	10	Gd	3	Absc.
88	H	715	972	622	.5	2	10.2	9	Gd-	3	Absc.
89	H	650	898	571	.6	6	13.8	8	Ch-	3	
90	H	660	1014	651	.6	4	13.9	8	Gd+	3	
91	H	590	883	561	.5	5-	12.2	6	Gd+	3	
92	H	805	1175	762	.6	2	13.1	11	Gd-	-	
93	Lim x	680	908	578	.5	4	11.0	8	Gd+	2	

Continued...

ASPEN BARK FEEDING TRIAL -- CONTROL (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
94	H	675	1002	643	.5	4	14.2	10	Gd+	3	Absc.
95	Ang	820	1171	759	.6	5	15.4	12	Ch-	3	
96	H	615	931	594	.8	4+	10.3	10	Gd	-	Absc.
97	H x Sh	925	1330	869	.4	3	13.6	14	Gd	2	Absc.
98	H	850	1197	777	.5	5	13.6	11	Ch-	3	Absc.
99	H	770	1168	757	.6	3	14.2	10	Gd	3	Absc.
100	H	725	1055	679	.4	4	13.0	9	Gd+	3	
16	H	615	1056	680	.5	4	12.1	11	Gd+	3	Absc.
Total											
Average											

ASPEN BARK FEEDING TRIAL -- ASPEN

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
101	Ch x H	575	1158	750	.5	3	14.1	13	Gd	2	
102	H	560	1085	700	.6	4	12.8	12	Gd+	-	
103	Ch x H	530	989	634	.5	5-	13.3	11	Gd+	2	
104*	BWF	595	988	633	.5	2	11.8	9	Gd-	-	Absc.
105	H	540	920	586	.5	4	11.9	8	Gd+	3	
106	Ch x H	500	1022	677	.5	3	14.1	12	Gd	2	
107	Red	530	978	626	.4	4	12.3	10	Gd+	2	
108	BWF	570	995	638	.5	3	12.1	11	Gd	3	
109	Bl x J	590	1007	646	.6	5-	10.1	10	Gd+	3	
110	Bl	565	978	626	.5	3	12.4	12	Gd	2	Absc.
111	Bl	690	1201	780	.7	5-	14.4	15	Gd+	3	
112	BWF	590	994	637	.5	6-	11.8	12	Gd+	2	
113	H	605	1002	643	1.0	4	11.2	11	Gd+	-	
114	H	655	976	625	.5	5	10.7	7	Ch-	3	Absc.
115	BWF	570	946	604	.5	4+	13.8	10	Gd+	3	
116	H	615	1042	670	.5	4-	12.3	10	Gd	2	
117	H	670	995	638	.5	2	13.6	9	Gd-	2	
118	H	605	1060	683	.6	5-	12.8	12	Gd+	-	Absc.
119	H	805	1144	741	.9	6	11.8	11	Gd+	-	
120	H	745	1060	683	.6	4+	13.8	12	Ch-	3	
121	H	750	1071	690	.6	5-	12.3	10	Gd+	3	
122	H	810	1105	714	.7	5	13.4	11	Ch-	3	
123	BWF	740	1046	673	.8	7	11.4	13	Ch	-	
124	Sht.	800	1144	741	.7	5	13.9	15	Gd+	-	
126	H	600	973	623	.6	3	11.9	9	Gd	3	
127	H	760	1079	696	.5	4+	13.8	12	Gd+	2	
128	H	700	1091	704	.5	2	14.4	11	Gd-	3	
129	Lim x	815	1140	738	.6	2	12.9	11	Gd-	3	
130	H	640	1091	704	.4	3	12.9	9	Gd	2	
131	Ch x H	855	1226	797	.8	5	12.5	11	Gd+	-	
132	Lim x	720	1033	664	.6	4+	11.9	13	Gd+	3	

*Bruised

Continued...

ASPEN BARK FEEDING TRIAL -- ASPEN (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
133	H	655	1031	663	.8	5	12.0	11	Ch-	3	
134	H	670	1017	653	.5	3	12.3	10	Gd	3	
135	H	715	1021	656	.5	3	15.1	10	Gd	2	
136	H	670	1037	667	.7	2	12.1	10	Gd-	-	
137	H	605	949	606	.6	4	11.1	10	Gd+	3	
138	H	675	1062	684	.7	5	12.3	12	Ch-	3	
139	H	785	1162	753	.8	7	12.7	8	Ch	-	
140	H	695	1060	683	.6	3	12.4	11	Gd	3	
141	H	660	857	543	.5	3	11.8	8	Gd	3	
142	Lim x	740	1042	670	.5	4+	14.0	12	Ch-	3	
143	Ch x H	635	1023	657	.5	6-	14.8	14	Gd+	2	
144	Ch x H	790	1201	780	.5	5-	14.8	13	Gd+	2	
145	Lim x	660	1023	657	.6	5-	13.8	8	Gd+	3	
146	Lim x	695	1105	714	.5	6-	12.1	10	Gd+	2	
148	Lim x	740	1107	715	.6	4	14.1	7	Gd+	3	
149	H	675	1091	704	.5	3+	12.2	9	Gd	3	
151	H	585	1020	655	.4	3	12.4	9	Gd	2	
152	Ch x H	536	1013	650	.4	4	12.1	10	Gd+	2	Absc.
153	BWF	535	965	617	.5	3	11.4	11	Gd	3	
154	H	560	979	627	.6	4	12.2	10	Gd+	3	Absc.
155	Brockle	525	924	589	.7	3	10.2	8	Gd	-	
156	Ch	580	1104	713	.7	4	14.1	12	Gd+	3	
157	BWF	560	944	603	.5	3	11.1	7	Gd	3	
158	Bl x J	605	984	630	.5	4-	13.1	9	Gd	2	
159	BWF	555	966	618	.5	4+	14.2	11	Ch-	3	Absc.
160	Bl	645	1050	676	.5	4+	14.2	9	Gd+	3	
161	BWF	545	1037	667	.7	5	10.3	10	Ch-	-	
162	BWF	545	975	624	.7	6	12.6	10	Ch-	3	Absc.
163	BWF	600	924	589	.5	5	14.1	9	Gd+	2	
164	H	710	1081	697	.6	5-	10.1	13	Gd+	-	
165	H	675	1023	657	.6	5	13.8	11	Gd+	3	
166	H	575	923	588	.5	4+	13.4	9	Gd+	3	
167	Brockle	695	1078	695	.5	4	13.5	13	Gd+	3	

Continued...

ASPEN BARK FEEDING TRIAL -- ASPEN (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
200	H	700	1055	679	.5	3	13.9	11	Gd	2	
NT	H		1055	679	.7	4+	15.1	10	Gd+	3	
Total											
Average											

ASPEN BARK FEEDING TRIAL -- ASPEN (CONTINUED)

Ear Tag	Breed	Starting Weight	Estimated Final Weight	Hot Carcass Weight	Fat Thickness	Marbling Score	Ribeye Area	Kidney Fat	USDA Grade	USDA Yield	Liver Condition
168	BWF	640.	1042	670	.6	7	13.2	12	Ch	3	
169	H	715	1023	657	.6	4+	12.9	8	Gd+	3	
170	Ch x BWF	865	1155	748	.6	7	14.9	13	Ch	2	
171	H	630	1030	662	.6	4	13.1	11	Gd+	3	
172	Ra x H	715	1010	648	.5	4	12.9	13	Gd+	3	Absc.
173	H	695	1018	654	.6	4	13.6	9	Gd+	3	
174	H	800	1124	727	.5	3	14.8	10	Gd	3	
175	Ch x H	935	1310	855	.5	3	15.6	15	Gd	3	
176	H	700	953	609	.6	4	12.9	11	Gd+	3	
177	Lim x	695	997	639	.5	5-	13.4	7	Gd+	3	
178	H	880	1246	811	.6	6	14.9	12	Gd+	3	
179	H	630	1002	643	.5	4+	13.8	12	Gd+	2	
180	BWF	710	1010	648	.5	5-	14.2	9	Gd+	3	
181	Lim x	650	1089	703	.5	5	14.1	9	Gd+	2	
182	Lim x	635	930	593	.6	5	13.4	9	Gd+	3	
183	H	775	978	626	.7	7	12.9	10	Ch	-	Absc.
184	H	600	927	591	.6	5	13.3	9	Gd+	3	
185	H	585	973	623	.6	5-	11.2	9	Gd+	3	
186	H	610	944	603	.7	7	12.1	9	Ch	3	
187	H	690	1044	672	.5	3	15.3	12	Gd	2	
188	H	690	1047	674	.6	4+	14.2	11	Gd+	3	Absc.
189	Lim x	520	873	554	.5	3	10.1	6	Gd	3	Absc.
190	H	720	1085	700	.6	4+	13.8	12	Gd+	3	
191	H	950	1234	803	.8	7	14.1	11	Ch	-	
192	Lim x	605	969	620	.4	4	13.6	11	Gd+	1	
193	H	770	1088	702	.5	2	14.1	9	Gd-	3	
194	Ang	675	1033	664	.5	4	14.2	12	Gd+	2	
195	BWF	755	1059	682	.7	5	13.6	11	Gd+	3	
196	Ch	645	902	574	.6	3	11.1	10	Gd	3	
197	Lim x H	780	1068	688	.6	6	13.4	15	Ch-	3	
198	H	780	1158	750	.6	6	14.2	11	Ch-	3	
199	H	585	959	613	.7	4	12.3	10	Gd+	3	

RESULTS OF 1975 SOUTH DAKOTA
ASPEN FEEDING TRIALS

A. PERCENT COMPOSITION OF THE EXPERIMENTAL RATIONS

Ration	Alfalfa	Aspen	Soybean Oil Meal	Molasses, Vitamins* and Mineral
Control	93	--	--	7
2	73	12	8	7
3	53	24	16	7
4	33	36	24	7
5	13	48	32	7
6†	13	48	32	7

* 67 g/ton of ration of vitamin A suppl. added (30,000 I.U. of Vitamin A/g).

† 4% sodium hydroxide added to aspen to aid animal utilization ration 6 only.

B. ACTUAL PURCHASE COST OF RATIONS

Alfalfa control	$115.75	Costs include $18.00/ton
12% aspen	$114.75	pelleting and bagging
24%	$107.00	charge. Costs do not in-
36% aspen	$ 99.70	clude transportation, cost
48% aspen	$ 93.20	of aspen material or
48% aspen+NaOH	$ 93.20	sodium hydroxide.

C. RESULTS

Animals Used: 60 Hereford steers (10 per each ration) average initial shrunk weight 704 pounds in two lots. Length of Trial: 3 weeks preliminary feeding on poor quality hay, 93 days on experimental rations.

	Control	12% aspen	24% aspen	36% aspen	48% aspen	48% aspen plus NaOH
At 32 days --						
Av. daily gain	0.94	1.48	3.16	3.56	3.27	3.63
Feed per lb of gain	20.3	13.54	7.53	6.88	7.12	6.58
At 57 days --						
Av. daily gain	1.69	2.90	3.52	3.32	3.17	3.17
Feed per lb of gain	15.63	10.26	8.08	9.04	8.31	9.59
At 93 days --						
Av. daily gain	1.55	2.23	2.77	2.83	2.72	2.62
Av. daily gain (shrunk)	1.26	2.02	2.68	2.67	2.42	2.44
Feed per lb of gain	17.42	14.93	12.30	11.94	10.80	12.84
Initial filled weight	728.4	727.8	722.7	726.3	725.0	726.7
Initial shrunk weight	707.8	705.1	702.1	702.1	704.9	704.9
Final filled weight	872.8	934.4	980.3	989.4	978.4	970.2
Final shrunk weight	825.8	893.3	937.4	951.3	930.1	931.7
Loss from final shrink	47.0	41.1	42.9	38.1	48.3	38.5

D. PRELIMINARY CARCASS QUALITY CHECK AT TERMINATION OF ASPEN FEEDING PHASE

After a growing phase, animals usually proceed into a finishing phase. However, a preliminary look was desired at the animals being fed the experimental rations before finishing. Thus, the animals were divided at 93 days: 24 animals (four from each ration type) to slaughter and used for taste panel; 24 animals (four from each ration type) continued on a finishing ration; and 12 animals (two from each ration type) used for a metabolism trial.

Slaughtered animals with no high energy feeding showed slight to moderate marbling which was reflected in no higher grade for any of the animals than good. Kidney fat ranged from 1.8 to 2.9%.

A 10-member taste panel scored the tenderness, flavor and juiciness of meat from the 24 animals giving higher ratings to aspen-fed animals as compared to the control alfalfa-fed animals. The panel found the meat to be tender and juicy with no off-flavor.

Additional information and copies of the final report may be obtained from: South Dakota State Division of Forestry, Department of Game, Fish & Parks, Sigurd Anderson Building, Pierre, South Dakota 57501, Phone: (605) 224-3623.